2-WIRE FOREIGN EXCHANGE SUBSCRIBER (2WFXS9 AND 2WFXS6) CHANNEL UNIT, 628190, AND 2-WIRE FOREIGN EXCHANGE SUBSCRIBER WITH EXTENDED VF RANGE (2WFXS/EVF) CHANNEL UNIT, 628192

GENERAL DESCRIPTION

CONTENTS PAGE

1. GENERAL 1
2. DESCRIPTION 1
3. FUNCTIONAL OPERATION (FIG. 3 AND 4) 2
HYBRID 2
TRANSMIT VF CIRCUIT 2
RECEIVE VF CIRCUIT 2
SIGNALING 5
CARRIER GROUP ALARM 6
BUSY MODE 6
4. OPTIONS 6
5. RESTRICTIONS 6
6. TEST AND MAINTENANCE FEATURES 6
7. TECHNICAL SUMMARY 7
8. REPLACEABLE PARTS 8
9. REFERENCES 8

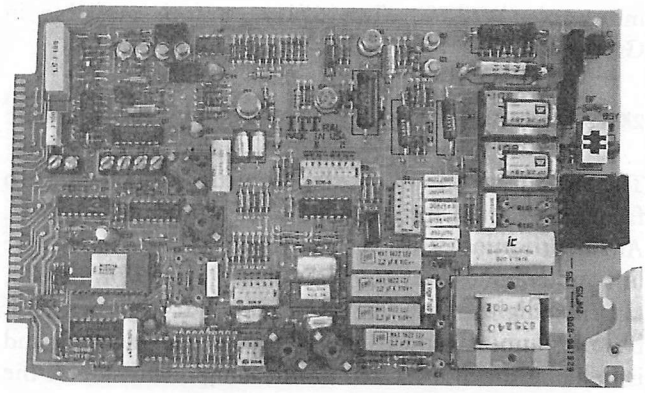


Fig. 1—2WFXS Channel Unit, 628190

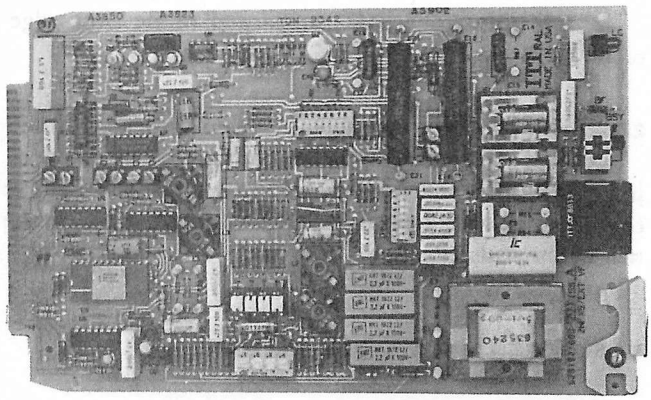


Fig. 2—2WFXS/EVF Channel Unit, 628192

1. GENERAL

1.01 This Section provides a general description of the ITT D448 2-wire foreign exchange subscriber (2WFXS9 and 2WFXS6) channel unit, 628190 (Fig. 1), and 2-wire foreign exchange subscriber with extended VF range (2WFXS/EVF) channel unit, 628192 (Fig. 2), to the functional block diagram level.

1.02 This Section has been reissued to add information on Group -1 of 2WFXS channel unit, 628190, and to include information on the handling of CMOS-equipped units.

1.03 The units provide a voice frequency (VF) and signaling interface between the subscriber drop and the D448 multiplex terminal common equipment. In the transmit direction, the units convert VF and signaling information into pulse code modulation (PCM) for application to the common equipment. In the receive direction, the units decode received PCM into VF and signaling information. During system outages, the units provide various disconnect/make-busy routines for the trunk. The units provide the subscriber end of a 900- or 600-ohm, ground-start or loop-start foreign exchange message circuit.

2. DESCRIPTION

2.01 Each unit mounts in the D448 multiplex shelf (channel unit mounting section) in connectors

J1A through J24A (for Digroup A) or connectors J1B through J24B (for Digroup B). Installation procedures for the units are provided in Section ITTR-18-440 (for the 628190 unit) or ITTR-18-441 (for the 628192 unit).

2.02 The 628190 unit is available in two groups. Group -0 provides 900-ohm plus 2.16-uF impedance matching. Group -1 provides 600-ohm plus 2.16-uF impedance matching. Group -0 is designated by the mnemonic 2WFXS9. Group -1 is designated by the mnemonic 2WFXS6. The 628192 unit is available in Group -0 only.

2.03 Each unit consists of an epoxy-glass printed circuit board (PCB) and associated circuit components. The lower front edge of the PCB is fitted with a handle to facilitate insertion and removal of the unit from the shelf. An identification strip on the handle face indicates the unit mnemonic (2WFXS9, 2WFXS6, or 2WFXS/EVF), last three digits of the model number, last three digits of the part number, and issue letter. The part number and issue letter are also located on the component side of the PCB.

2.04 The LC LED (DS1), the BSY switch (S5), and the splitting card jack (J1) are located on the front edge of the PCB.

2.05 Printed circuit wiring is etched on both sides of the PCB. The unit inputs and outputs are terminated in gold-plated contacts on the rear edge of the PCB. These contacts mate with a 60-pin contact edge connector on the rear of the multiplex shelf.

3. FUNCTIONAL OPERATION (FIG. 3 AND 4)

HYBRID

3.01 The hybrid is toll-grade and provides 28-dB (minimum) echo return loss and a 20-dB (minimum) singing return loss. Either the internal compromise network (by selecting DIP switch option [CN]) or an external precision balance network (PBN) may be used to balance the hybrid. Regardless of whether the internal compromise network or an external PBN is used, additional build-out capacitance may be paralleled across it by selecting DIP switch options [2] through [64]. Build-out capacitance from 0.002 to 0.126 uF in 0.002-uF steps may be selected. The NT and NR leads are brought out for connection to an external PBN. If an external PBN is used, the [CN] DIP switch should be opened (not selected).

3.02 On the 2WFXS channel unit, the hybrid circuit provides talk battery and ground to the drop through a nominal resistance of 515 ohms. On the 2WFXS/EVF channel unit, option screws [LL1] and [LL2] allow talk battery and ground to be provided to the drop through 490 ohms (option screws down) or 990 ohms (option screws up).

TRANSMIT VF CIRCUIT

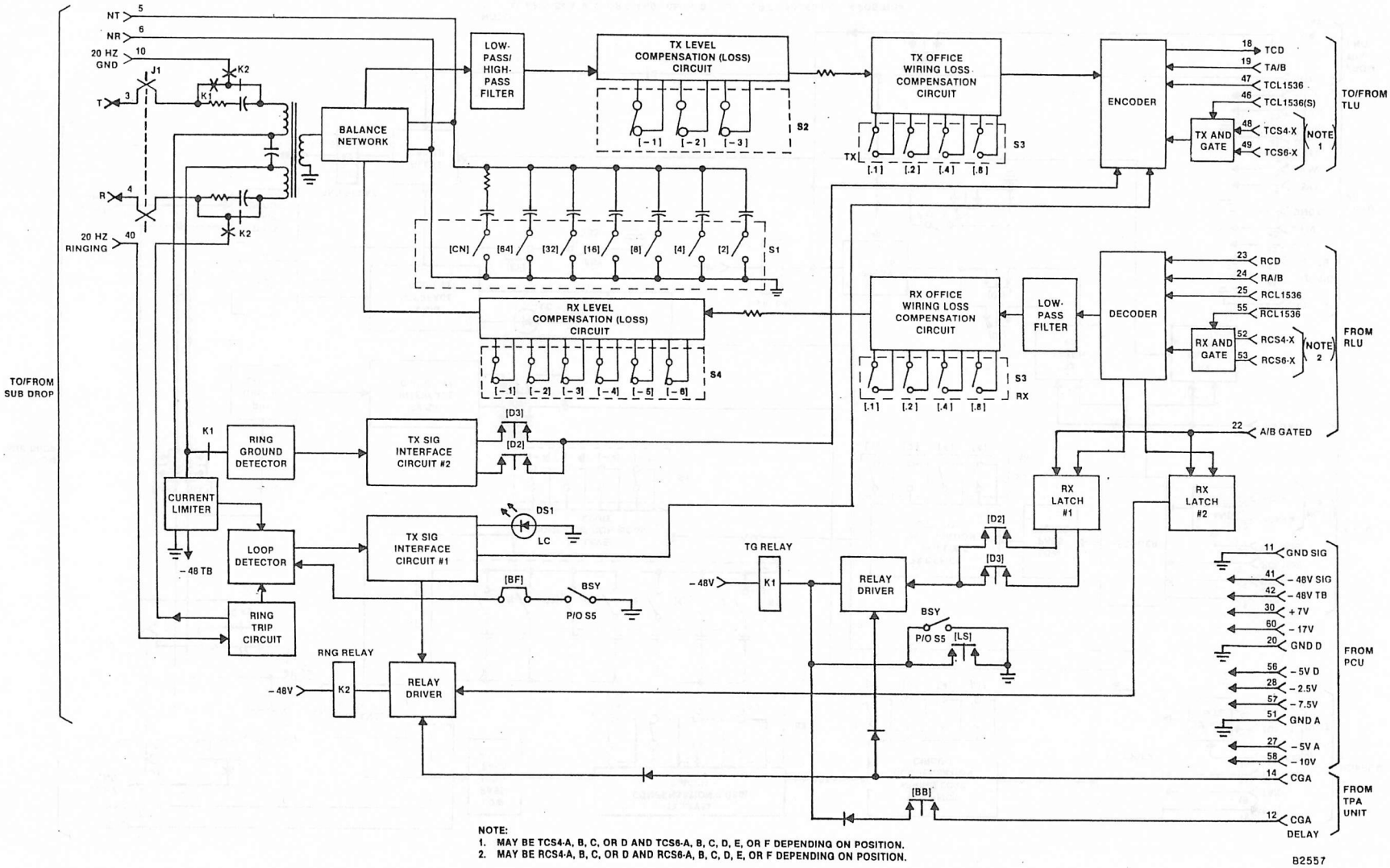
3.03 The incoming VF is transformer-coupled to the low-pass/high-pass filter where it is amplified and filtered. The gain applied to the input signal can be varied in 1-dB steps from 0 to -3.0 dBm on the 2WFXS unit or from $+6.0$ to -9.0 dBm on the 2WFXS/EVF unit by the selection of the transmit (TX) level DIP switch options. (On the 2WFXS unit, only one DIP switch option [-1], [-2], or [-3] should be selected; on the 2WFXS/EVF, any number of DIP switch options may be selected and the total of the numbers adjacent to each "ON" switch should be added to -9 dBm to obtain the correct transmit level at the tip and ring.) The resulting signal is passed to the TX office wiring loss (OWL) compensation circuit. The TX prescription OWL options provide 0 to 1.5 dB of gain in 0.1-dB steps to the signal applied to the encoder to compensate for office wiring/cabling losses. The resultant range for input levels is 0 to -4.5 dBm in 0.1-dB steps for the 2WFXS and $+6.0$ to -10.5 dBm in 0.1-dB steps for the 2WFXS/EVF. (On the 2WFXS/EVF, the level should not be set above $+6$, TX and RX, to ensure proper operation with a $+3.0$-dBm0 overload point, $+9$.)

3.04 The encoder converts the VF signal and signaling information (Para. 3.07) to an 8-bit PCM word. When the TX AND gate is activated by the transmit logic unit (TLU) on the TCS4-X and TCS6-X leads, the 8-bit word is applied to the TLU via the TCD bus. The data is clocked out of the unit under control of the 1.536-MHz clock from the TLU.

RECEIVE VF CIRCUIT

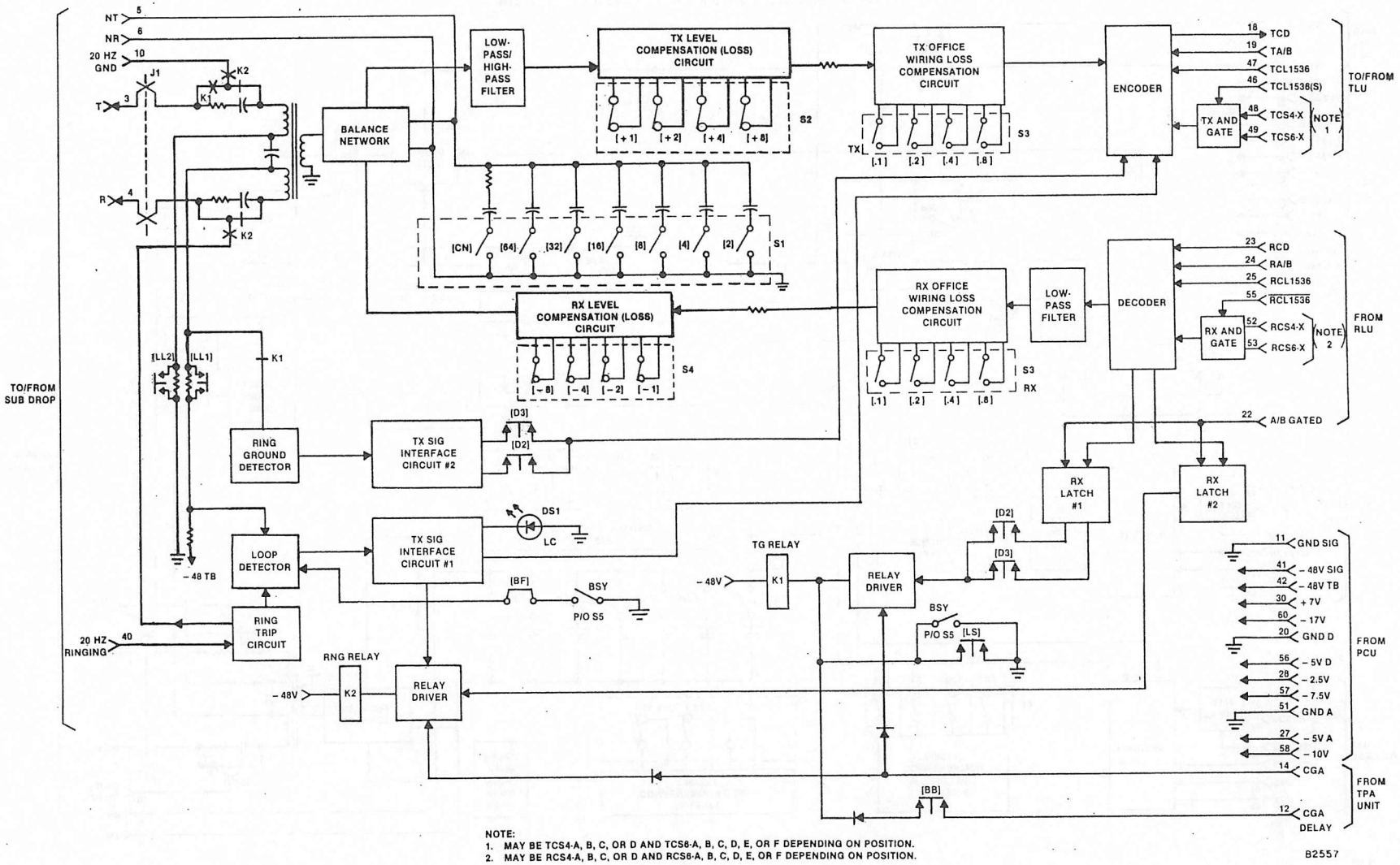
3.05 An 8-bit PCM word from the receive logic unit (RLU) is applied to the decoder on the RCD bus. The decoder will only accept the data when the receive (RX) AND gate is activated by the RLU on the RCS4-X and RCS6-X leads. The decoder converts the PCM word into a VF signal and signaling information (Para. 3.08).

3.06 The VF signal is applied to the low-pass filter and passed through to the RX OWL compensation circuit. The RX prescription OWL options provide 0 to 1.5



NOTE:
1. MAY BE TCS4-A, B, C, OR D AND TCS6-A, B, C, D, E, OR F DEPENDING ON POSITION.
2. MAY BE RCS4-A, B, C, OR D AND RCS6-A, B, C, D, E, OR F DEPENDING ON POSITION.

Fig. 3—2WFXS Channel Unit, 628190, Functional Block Diagram



NOTE:
1. MAY BE TCS4-A, B, C, OR D AND TCS6-A, B, C, D, E, OR F DEPENDING ON POSITION.
2. MAY BE RCS4-A, B, C, OR D AND RCS6-A, B, C, D, E, OR F DEPENDING ON POSITION.

Fig. 4—2WFXS/EVF Channel Unit, 628192, Functional Block Diagram

dB of gain in 0.1-dB steps to the signal out of the low-pass filter to compensate for office wiring/cabling losses. The output of this circuit is further amplified. This amplification can be varied in 1-dB increments over a 6-dB range with the 2WFXS unit and over a 15-dB range with the 2WFXS/EVF by the selection of RX VF level DIP switch options. On the 2WFXS unit, only one DIP switch option [−1] through [−6] should be selected; on the 2WFXS/EVF unit, any number of DIP switch options may be selected to provide the required level at the T and R leads. This provides output levels of +1.5 to −6.0 dBm on the 2WFXS unit and +6.0 to −9.0 dBm on the 2WFXS/EVF unit in 0.1-dB increments with both the OWL and VF level options. The amplified VF is transformer-coupled to the subscriber drop.

SIGNALING

A. General

3.07 Signaling information from the subscriber to the units is via the T and R leads. The signaling information is processed via transmit signaling circuitry and the TX signaling (SIG) interface circuits. The output of the TX SIG interface circuits is applied to the encoder. However, the encoder will not process the information until it is signaled on the TA/B lead by the TLU that the signaling frame is upcoming. Each TX SIG interface circuit is associated with a different signaling frame.

3.08 Signaling information from the far-end 2-wire foreign exchange office (2WFXO) channel unit is applied to the decoder along with the VF information from the far end. The decoder converts the receive signaling information from the 8-bit PCM word when it is signaled by the RLU on the RA/B lead that the signaling frame is being processed by the terminal. Each RX latch is associated with a different signaling frame. The RX latches and other receive signaling circuitry process the signaling information. This causes signaling conditions to be placed on the 2-wire drop to the C.O.

3.09 During intermittent terminal failures (momentary failures), the RX latches are inhibited from processing signaling information (signaling state storage). This forces the unit to remain in its previous state (idle or busy) during the momentary failure to keep from dropping connections or to keep the unit from being accessed. The signaling state storage is controlled by the RLU. During a momentary failure, the RLU prevents the A/B GATED lead from making a transition which inhibits the RX latch.

B. Outgoing Call

3.10 The following paragraphs describe the signaling functions of the units when a call is being processed from the subscriber to the far-end 2WFXO channel unit.

3.11 The unit is seized when its loop is closed by the subscriber. In ground-start operation, its R lead is grounded at the same time. In loop-start operation, a permanent ground is present on its T lead by closing option screw [LS] which energizes the TG relay.

3.12 In ground-start operation, the units do not recognize the loop closure because the T lead is open. However, the ground on the R lead is detected by the ring ground detector and sent to the far end via TX SIG interface circuit #2. Option screws [D2] and [D3] condition the signaling to be compatible with D2-type signaling or D3-/D1D-type signaling, respectively. The far-end 2WFXO applies ring ground to the C.O. The C.O. recognizes this as a request for service from the 2WFXS or 2WFXS/EVF and grounds the T lead going to the 2WFXS or 2WFXS/EVF. This tip ground information is sent to the 2WFXS or 2WFXS/EVF. The tip ground information is applied to RX latch #1 which energizes the TG relay, causing the T lead to be grounded. This completes the loop at the 2-wire drop and permits dialing to take place. Dialing occurs by pulsing of the loop at the 2-wire drop. The opening and closing of the loop is detected by the loop detector which applies this information to the far end via TX SIG interface circuit #1. TX SIG interface circuit #1 turns on the LC LED when the loop is closed. The loop pulsing is sent to the far-end 2WFXO which opens and closes its loop to recreate the dial pulsing at the 2-wire drop to the C.O. At the conclusion of dialing, the talk path from the 2WFXS or 2WFXS/EVF to the 2WFXO is complete.

3.13 In loop-start operation, the T lead at the 2-wire drop is permanently grounded. When the loop from the subscriber is closed, it is detected by the loop detector which applies this information to TX SIG interface circuit #1. TX SIG interface circuit #1 sends this information to the far-end 2WFXO which consequently closes the loop to the C.O. The C.O. recognizes this as a request for service from the 2WFXS or 2WFXS/EVF. Since the loops at both ends are now complete, dialing from the 2WFXS or 2WFXS/EVF can now take place. Dialing occurs by pulsing of the loop at the 2-wire drop. The opening and closing of the loop is detected by the loop detector which applies this information to the far end via TX SIG interface circuit #1. TX SIG interface circuit #1

turns on the LC LED when the loop is closed. The loop pulsing is sent to the far-end 2WFXO which opens and closes its loop to recreate the dial pulsing at the 2-wire drop to the C.O. At the conclusion of dialing, the talk path from the 2WFXS or 2WFXS/EVF to the 2WFXO is complete.

C. Incoming Call

3.14 The following paragraphs describe the signaling functions of the units when a call is being processed from the far-end 2WFXO to the subscriber.

3.15 The C.O. grounds the tip lead at the far-end 2WFXO and applies ringing voltage to its tip and ring leads. In loop-start operation, a ground is permanently applied by the 2WFXO. In either mode of operation, the 2WFXO sends the tip ground information to the 2WFXS or 2WFXS/EVF via RX latch #1. RX latch #1 energizes the TG relay which grounds the T lead to the subscriber. This completes part of the ringing path and inhibits the 2WFXS or 2WFXS/EVF from sending a ring ground signal to the far end.

3.16 The ringing voltage signal from the far end is applied to the 2WFXS or 2WFXS/EVF via RX latch #2. RX latch #2 energizes the RNG relay. This causes 20-Hz negative superimposed ringing voltage to be applied on the T and R leads to the subscriber. When the loop detector senses a loop closure at the 2-wire drop, it trips ringing via the ring trip circuit and applies the loop closure information to the TX SIG interface circuit #1. TX SIG interface circuit #1 turns on the LC LED and sends the loop closure information to the far end. The loop closure transmitted to the far end causes the 2WFXO to close its loop to the C.O. This completes the talk path from the 2WFXO to the 2WFXS or 2WFXS/EVF.

CARRIER GROUP ALARM

3.17 During a system outage, two carrier group alarm (CGA) signals (CGA immediate ground and CGA delayed ground) and option screw [BB] control the CGA functions of the unit. When a CGA occurs, the CGA lead provides an immediate ground to the unit, and the CGA DELAY lead provides a delayed ground to the unit. Both grounds remain until the CGA condition is cleared. Strapping options on the backplane of the multiplex shelf control when the CGA immediate ground occurs after an alarm signal is received.

3.18 When the CGA lead is grounded, both the TG and RNG relays are deenergized. This removes tip ground and ringing signals from the 2-wire drop.

3.19 When the CGA DELAY lead is grounded, and option screw [BB] is selected, the TG relay is energized. This provides a tip ground to the subscriber.

BUSY MODE

3.20 When the BSY switch is placed in the BSY position, the TG relay is energized and ringing is inhibited. This provides a tip ground to the subscriber. If option strap [BF] is installed, a loop closure signal is forwarded to the far end via TG SIG interface circuit #1.

4. OPTIONS

4.01 The units are equipped with DIP switch options, screw-down options, and strapping options for selecting circuit options. Refer to Section ITTR-18-440 (for the 628190 unit) or ITTR-18-441 (for the 628192 unit) for detailed information on option selection.

4.02 The multiplex shelf provides options on the backplane which control the CGA timing of the terminal. Refer to Section ITTR-18-405 (for shelves mounted in 23-inch bays) or ITTR-18-406 (for shelves mounted in 19-inch bays) for option selection information on these options.

5. RESTRICTIONS

WARNING: These units contain static-sensitive (CMOS) devices. Section ITTR-18-599 contains handling instructions for CMOS-equipped units.

6. TEST AND MAINTENANCE FEATURES

6.01 A description of the test and maintenance features of the unit is provided in Table A. Refer to Fig. 1 and 2 for the physical location of these features.

TABLE A

FEATURE	REF. DES.	FUNCTION
LC LED	DS1	Turns on when a loop closure is present at the 2-wire drop.
BSY Switch	S5	When placed in BSY position, provides tip ground; with option strap [BF] installed, loop closure also sent to far end.
Splitting Card Jack	J1	Provides test/break jack access to C.O. equipment and channel unit drop sides of T and R leads.

7. TECHNICAL SUMMARY

7.01 A summary of technical specifications for the unit is given in Table B.

TABLE B

ITEM	SPECIFICATION	
DC POWER		
Voltage	**Current Drain (nominal)**	
	Idle	**Busy**
+ 5V (GND)		
2WFXS	27.0 mA (at 5V)	37.0 mA
2WFXS/EVF	25.0 mA (at 5V)	41.0 mA
− 10V	2.0 mA (at 5V)	2.0 mA (at 5V)
+ 7V	4.0 mA (at 12V)	4.0 mA (at 12V)
− 17V	8.0 mA (at 12V)	9.0 mA (at 12V)
− 48V SIG Battery		
2WFXS	0 to 12 mA depending on signaling condition	
2WFXS/EVF	0 to 14 mA depending on signaling condition	
− 48V Talk Battery		
2WFXS	1.0 mA idle, plus loop current	
2WFXS/EVF	Loop current plus 4.5 mA ring ground	
VF PERFORMANCE		
Impedance		
2WFSX9 and 2WFXS/EVF	900 ohms plus 2.16 uF	
2WFXS6	600 ohms plus 2.16 uF	
Levels		
Transmit		
2WFXS	0 to − 4.5 dBm, adjustable in 0.1-dB steps	
2WFXS/EVF	+ 6.0 to − 10.5 dBm adjustable in 0.1-dB steps*	
Receive		
2WFXS	+ 1.5 to − 6.0 dBm, adjustable in 0.1-dB steps	
2WFXS/EVF	+ 6.0 to − 9.0 dBm adjustable in 0.1-dB steps*	
Loss Stability (End-to-End)	± 0.5 dB over life in 95% of the circuits	

TABLE B (CONT)

ITEM	SPECIFICATION
Tracking (End-to-End)	
− 37 to + 3 dBm0 Input	0.5 dB maximum deviation
− 50 to − 37 dBm0 Input	1.0 dB maximum deviation
Idle Channel Noise (End-to-End)	23 dBrnc0 maximum
Signal-to-Distortion	
0 to − 30 dBm0 Input	33 dB minimum overall; 35 dB minimum receive or transmit
− 40 dBm0 Input	27 dB minimum overall; 29 dB minimum receive or transmit
− 45 dBm0 Input	22 dB minimum overall; 25 dB minimum receive or transmit
Single Frequency Distortion (at 0 dBm0)	
Input Swept from 0 to 12 kHz	− 28 dBm0 maximum at any other frequency
Input between 1004 and 1020 Hz	− 40 dBm0 or less at any other frequency of 0 to 4 kHz with a distortion contribution objective from either transmit or receive of typically 6 dB better
Transhybrid Loss (900 Ohms)	
200 to 500 Hz	20 dB
500 to 1000 Hz	30 dB
1000 to 2500 Hz	35 dB
2500 to 3400 Hz	30 dB
Transhybrid Loss (600 Ohms)	
200 to 500 Hz	20 dB
500 to 1000 Hz	28 dB
1000 to 2500 Hz	30 dB
2500 to 3400 Hz	28 dB
Echo Return Loss (Measured against nominal impedance with 25 ohms in series with channel unit and no far-end channel unit)	28 dB minimum

*Maximum range meeting all performance specifications.

TABLE B (CONT)

ITEM	SPECIFICATION
Singing Return Loss (Measured against nominal impedance with 25 ohms in series with channel unit and no far-end channel unit)	20 dB minimum
Frequency Response (Referenced to 1020 Hz, End-to-End) 900 Ohms	
60 Hz	20.0 dB minimum loss
200 Hz	0 to −5.0 dB
300 to 3000 Hz	+0.5 to −1.0 dB
3200 Hz	+0.4 to −1.5 dB
3400 Hz	0 to −3.0 dB
Frequency Response (Referenced to 1000 Hz at 0 dBm0, End-to-End) 600 Ohms	
600 to 2400 Hz	±1.0 dB
300 to 3400 Hz	+1.0 to −3.0 dB
Balance Network	Compromise network of 900 or 600 ohms + 2.16 uF built-in and with BOC in 0.002-uF steps to 0.126 uF (NT and NR brought out for connection to external precision balance network)
Delay Distortion (End-to-End)	94 PAR (minimum)
Longitudinal Balance (AT&T Method)	
200 Hz	66 dB minimum
1000 Hz	60 dB minimum
3000 Hz	58 dB minimum
Longitudinal Balance (IEEE Method)	
200 Hz	60 dB minimum
1000 Hz	60 dB minimum
3000 Hz	58 dB minimum
SIGNALING	
Pulsing Distortion	
Input (at FXS)	Loop pulsing at 12 pps, 64% break, with 1500 ohms external circuit resistance†
Output (at FXO)	69% break maximum
Input (at FXS)	Loop pulsing at 12 pps, 58% break, 4 C4A ringers, and 15 k ohms leak resistance‡
Output (at FXO)	43% break minimum
Loop Range	0 to 2000 ohms
Tip Ground Disconnect Delay	125 to 300 msec
†Option screws [LL1] and [LL2] selected (down) on 2WFXS/EVF unit. ‡Option screws [LL1] and [LL2] not selected (up) on 2WFXS/EVF unit.	
OPERATING ENVIRONMENT	
Temperature	0 to +55°C
Humidity	To 95% at 40°C (no condensation)
Altitude	To 14,000 ft (4,300 m)
DIMENSIONS	
Width	0.8 in. (1.9 cm)
Height	5.9 in. (15.0 cm)
Depth	9.7 in. (24.6 cm)
WEIGHT	1.2 lb (0.5 kg)

8. REPLACEABLE PARTS

8.01 These units have no field-replaceable parts.

9. REFERENCES

9.01 The engineering drawings noted in Table C were used in the preparation of this Section.

TABLE C

TYPE	DRAWING NO.
Assembly	628190-000
Schematic	628190-002
Assembly	628192-000
Schematic	628192-002

9.02 Related information on the units may be found in the ITTR Sections referenced in Table D.

TABLE D

TITLE	SECTION NO.
Connectorized Multiplex Shelf (MS/WC7, MS/WC5, MS/C7 and MS/C6), 628001, 628005, 628011 and 628015 (For 23-Inch Bays) — Option Selection, Installation and Pretest	ITTR-18-405
Connectorized Multiplex Shelf (MS19/WC7, MS19/WC5, MS19/C7 and MS19/C6), 628003, 628008, 628013 and 628018 (For 19-Inch Bays) — Option Selection, Installation and Pretest	ITTR-18-406
Trunk Channel Units — Option Selection and Installation	ITTR-18-440
Special Service Channel Units — Option Selection and Installation	ITTR-18-441